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ABSTRACT

A discussion is presented of the relationship between community college general education mathematics courses and the technical education curricula they support. Introductory remarks sketch the history and emphasis of community colleges; review President Truman's Commission on Higher Education's recommendations concerning the functions of community colleges; and list the National Commission on Excellence in Education's indicators of risk that are relevant to mathematics and general education. The report then identifies and discusses four areas involved in the process of interaction between mathematics departments and vocational-technical education departments: (1) the establishment of standards for both entrance and exit competencies; (2) the evaluation of incoming students relative to entrance competencies; (3) the specification of remediation for those not qualifying for unconditional entrance; and (4) the maintenance of standards in determining academic progress. The problems and issues inherent in each one of these areas are addressed, and solutions are suggested which focus on the concept of "ownership," that is, the responsibility an instructor, department, or institution accepts for the success or the deficiencies demonstrated by the graduates of a program. The paper concludes with the argument that "ownership" must be accepted by general education faculty as well as vocational/technical faculty. (LAL)

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OCCUPATIONAL EDUCATION AND MATHEMATICS:

OWNERSHIP MAKES THE DIFFERENCE

A Paper

For Presentation to

the SLOAN FOUNDATION-sponsored Conference on

NEW DIRECTIONS in TWO-YEAR COLLEGE MATHEMATICS

to be held at

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OCCUPATIONAL EDUCATION and MATHEMATICS:

OWNERSHIP MAKES THE DIFFERENCE

A discussion of the relationship between community college general education math courses and the technical education curricula that they support, with a stress on problems which are evident in that relationship and some possible solutions, requires first an understanding of institutional mission and the fit of specific program efforts within the mission. Therefore, a sketch of the history and emphasis of community colleges by which we can gain that perspective is necessary.

The term "community college" was coined officially by President Truman's Commission on Higher Education in its report issued on December 11, 1947. From that time on the terms "junior college" and "vocational/technical institute" described inadequately institutions that were designed to serve the communities in which they are located. The vision of the Commission focused on the essential characteristics of community colleges -- that they function truly as a community resource and that they "belong" to the community. Also, the Commission recommended that in addition to offering the first two years of a four-year or professional degree, the community college should:

1. Conduct community surveys to determine community needs.
2. Offer programs designed to meet the needs of a cross-section of the population, including older adults who need to alternate their time between work and college attendance.
3. Integrate general education and vocational/technical education.
4. Serve as a center for a comprehensive program of adult education. (Vaughan, pp. 22-23)

These essential characteristics are as relevant and appropriate now as they were when they were conceived in 1947. They underscore what is central to community college activities today. We, as a community college system, continue to survey our communities, offer programs to meet the needs of the diverse individuals who attend our institutions, attempt to integrate general education into our vocational-technical education programs, and offer comprehensive programs for adults. The four essential characteristics identified by the Commission are primary to the community college mission as is the more traditional transfer characteristic. To resolve the mathematics dilemma in the community college requires that these characteristics be understood as the basis

upon which solutions must be devised.

The National Commission on Excellence in Education cited 13 indicators of risk in their report A Nation at Risk. The following eleven are relevant to the area of mathematics as they are to other areas of general education:

> International comparisons of student achievement, completed a decade ago, reveal that on 19 academic tests American students were never first or second and, in comparison with other industrialized nations, were last seven times. . . .
>
> Average achievement of high school students on most standardized tests is now lower than 26 years ago when Sputnik was launched.
>
> Over half the population of gifted students do not match their tested ability with comparable achievement in school.
>
> The College Board's Scholastic Aptitude Tests (SAT) demonstrate a virtually unbroken decline from 1963 to 1980. Average verbal scores fell over 50 points and average scores dropped nearly 40 points.
>
> College Board achievement tests also reveal consistent declines in recent years in such subjects as physics and English.
>
> Both the number and proportion of students demonstrating superior achievement on the SATs (i.e., those with scores of 650 or higher) have also dramatically declined.
>
> Many 17-year-olds do not possess the "high order" intellectual skills we should expect of them. Nearly 40 percent cannot draw inferences from written materials; only one-fifth can write a pursuasive essay; and only one-third can solve a mathematics problem requiring several steps.
>
> There was a steady decline in science achievement scores of U.S. 17-year-olds as measured by national assessments of science in 1969, 1973, and 1977.
>
> Between 1975 and 1980, remedial mathematics courses in public 4-year colleges increased by 72 percent and now constitute one-quarter of all mathematics courses taught in those institutions.
>
> Average tested achievement of students graduating from college is also lower.
>
> Business and military leaders complain that they are required to spend millions of dollars on costly remedial education and training programs in such basic skills as reading, writing, spelling, and computation. The Department of the Navy, for example, reported to the Commission that one-quarter of its recent recruits cannot read at the ninth grade level, the minimum needed simply to understand written safety instructions. Without remedial work they cannot even begin, much less complete, the sophisticated training essential in much of the modern military. (pp. 8-9)

Although this disturbing report addresses public secondary education

primarily, the reactions it will cause will greatly impact programs in higher education. National discussions, deliberations, and decisions on new directions to be taken in response to the recommendations must be holistic, folding in the interests of mathematics teachers, students, and employers. They must also be sensitive to the institution's financial resources. Our directions must be responsive to community needs as a whole with the concerns of the students and graduates foremost in our decisions.

The process of interaction between mathematics departments and departments of vocational-technical education involves at least four areas:

1. Establishment of standards (both entrance and exit competencies).

2. Evaluation of incoming students (relative to the entrance competencies).

3. Specification of remediation (for those not qualifying for unconditional entrance).

4. Maintenance of standards in determining academic progress.

STANDARDS

Standard-setting is a serious problem because of the sizeable numbers of colleges and their diversity. There were 1,219 community, technical, and junior colleges listed in the 1983 Community, Technical and Junior College Directory with state-wide student enrollments ranging from 1,201 to 1,221,430 and institutional enrollments ranging from a low of 132 full-time equivalent students to a high of 30,820. Setting uniform national standards that satisfactorily account for such diversity would take genius and ingenuity that is rare in education today.

Other issues that complicate standard-setting include:

1. Secondary schools' concerns that moving from open admissions to the setting of admissions standards will keep out applicants who would gain from a two-year college experience.

2. Instructional departments' (including general and occupational education) fears that the lack of standards will lead to erosion of a well-earned reputation.

3. Employer concerns that graduates may be certified with a diploma, certificate, or degree, yet, not be competent in the selected field of employment.

Pertinent to these concerns and fears is the institutional, departmental, and faculty perception of "ownership" -- that is, the responsibility an instructor, department, or institution (as well as any

of the other constituencies -- such as advisory committees) accepts for the success or the deficiencies demonstrated by the graduates of a program.

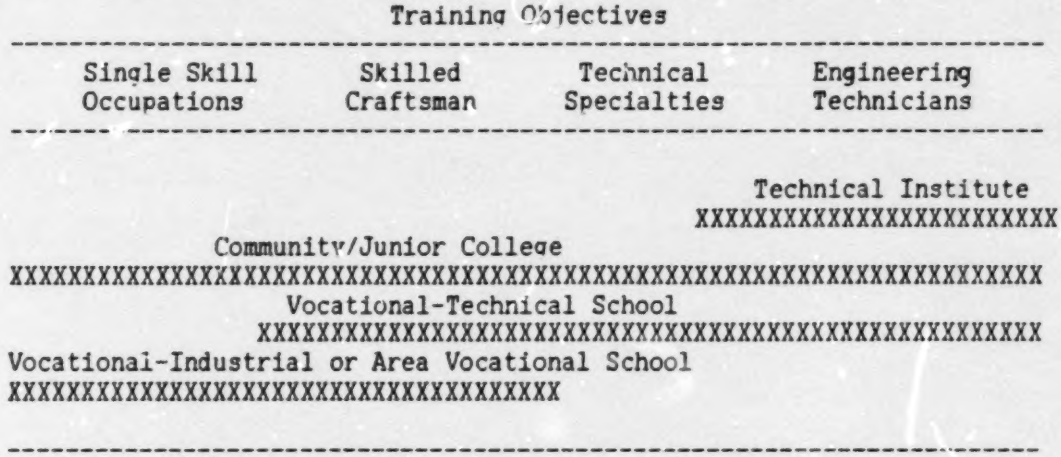
Vocational/technical education historically has had a special burden to carry and has had to justify its existence more than any other curricula area. Institutions that offer postsecondary vocational/technical education funded in part by federal vocational funds are continually active in writing grant proposals, establishing technical advisory committees, filing state and federal end-of-the-year reports, and carrying out follow-up studies of their graduates. Vocational/technical department faculty become intimately involved in this process. Also, they work closely with students and employers. When a graduate from a vocational/technical department fails to exhibit the skills, knowledge, and attitudes expected by his/her new employer, it is the vocational/technical department and faculty as well as the graduate that bears the blame, that suffers the indignity. The institution is viewed negatively, the faculty is viewed deficient, or worse, and the department is, perhaps, viewed as being out of step with employers. Generally, the problems are brought to the attention of the institution and corrective actions are taken quickly. However, the most immediate and positive corrective action will be taken when "ownership" is accepted by all those involved.

Another term related to "ownership" to explain what I have in mind here is "partnership". One of the small ironies that I see in the rhetoric of community colleges today is that we tend to apply our best selves, our greatest energies, our best thoughts to relationships with individuals, programs, and organizations in the community. We do not apply ourselves nearly as rigourously to our own in-house operations. In a way our institutional behavior is like that of a person who is marvelously personable with strangers and acquaintances but horrid with his/her own family. That is, we speak a great deal about building partnerships with local business, with labor unions, with professional associations, with churches, and with other power groups in the community -- but we do not apply the same drives to our in-college operations. I feel very strongly that we need to be just as helpful and service oriented -- just as cooperative -- within the college as we are within the community. My use of the term "ownership" and "partnership" implies these behaviors.

To establish particular program standards requires that programs be developed with performance standards acceptable to both employers and the institution. Greer (1967) in a study of technical education described a conceptual model that recognizes the overlapping functions of institutions with an occupational education mission (the term "occupational education" includes both vocational and technical education). This broad occupational spectrum -- from a single skill occupation to multi-skilled engineering technician -- results in state, regional, and local program differences of significant proportion and interpretations of standards that cloud the issues in bringing about relevance to general education courses. These differences in programs and standards further complicate the efforts to bring about positive changes. As can be seen in Figure 1 following, the truly comprehensive community college covers the entire occupational spectrum below the engineering technician or para-professional, whereas the

vocational-technical school (vocational-technical institute as considered here) covers a narrower spectrum of postsecondary programs, and the technical institute has an even more narrowly defined function. The fourth category in Figure 1, the vocational-industrial or area vocational school, is at the secondary level and is omitted from this discussion.

Figure 1. OVERLAPPING FUNCTIONS OF DIFFERENT TYPES OF SCHOOLS



Although the community, technical, and junior colleges cover all occupational education levels, from the single skill occupations to the technician and para-professional occupations, the predominant emphasis is on the upper three categories -- the skilled craftsman, technical specialties, and engineering technicians.

Using the upper categories to establish a base line for developing both entrance and graduate standards, an acceptable definition of technical education is necessary to demonstrate the necessity of general education. The following definition serves the purpose of this discussion:

> Technical Education -- That body of knowledge organized in a planned sequence of classroom and laboratory experiences, usually at the postsecondary level, to prepare pupils for a cluster of job opportunities in a specialized field of technology. The program of instruction normally includes the study of the underlying sciences and supporting mathematics inherent in a technology, as well as methods, skills, materials, and processes commonly used and services performed in the technology. A planned sequence of study and extensive knowledge in a field of specialization is required in technical education, including competency in the basic communications skills and related general education. Technical education prepares for the occupational area between

> the skilled craftsman and the professional person such as the doctor, the engineer, and the scientist. (U. S. Office of Education, 1969, p. 85)

Most significant in the definition is the inclusion of the reference to "the study of the underlying sciences and supporting mathematics inherent in a technology" as well as "competency in the basic communications skills and related general education". In stating the need of supporting mathematics, it is clear that technical education includes mathematics instruction. Technical courses and math courses are inseparable units in any technical education curricula. Technical education cannot be offered without the essential contribution of mathematics instruction. The relationship is symbiotic.

One hundred-eight senior executives from a random sample of Fortune 1300 companies endorsed the importance of this significant relationship. In a national survey of the firms, 76 percent responded that competency tests in writing skills and math should be administered prior to hiring of secretaries, clerks, first-line managers, and middle-level managers. Thirty-eight percent indicated that tests should be administered to hourly factory workers. Ninty-two percent also responded that public schools should be responsible for teaching computer use, with 58 percent indicating that such courses should be required and 42 percent indicating they should be optional (Research & Forecasts, Inc.).

Further, Koltai reports that " . . . the abilities of reading, writing, computing, and communicating are prized by business and industry above more specific job-related skills" (p. 21). There are those who counter this position by observing that if the job-related skills -- that is, the vocational/technical skills -- had not been developed at the time of hire, the general education skills of reading, writing, computing, and communicating would most surely move to a lower priority than the job-related abilities. This strongly suggests that a balance between the general education and occupational skills must be created to produce program graduates whose skills meet employer requirements and whose performance on the job substantiate a college's reputation.

The issues of integrity and consistency were foremost in the discussions of roundtable participants convened by the American Association of Community and Junior Colleges to formulate a policy statement on the meaning of the associate degree. The associate degree was reaffirmed "as central to the mission of the community, technical, and junior college" (p. 2). Explicit in this reaffirmation is the responsibilty of the institution to "establish and maintain excellence in all educational programs . . . by providing the individual with the currency to negotiate the next step, whether that step be into full-time employment or into a baccalaureate degree program" (p. 2). Further, the organization of the curriculum "must include the opportunity for the student to demonstrate proficiency in the use of language and computation, for whatever their career goals, students will be called upon to exercise competence in those areas." The program should include "a level of general education that enables the individual to understand and appreciate his/her culture and environment" and "the attainment of skills in analysis, communication, quantification, and synthesis

necessary for further growth as a lifespan learner and a productive member of society" (p. 3).

It is apparent in the educational process "that the buck stops" at the faculty level in resolving, on one hand, the commitment to standards by the institutions, and, on the other hand, the expectations by those receiving the graduates -- society in general, baccalaureate institutions, and employers. Standard-setting demands interaction among the program constituents -- faculty (both program faculty and general education faculty) and employers. The standards thus set should appropriately reflect the realistic competencies for initial employment as well as for career mobility -- employment adaptability skills to provide for upgrading and promotion. The success or failure of students should be attributed equally to the general education faculty and to the faculty in the student's major technical department. This "ownership" component will ensure agreement and appropriateness between the program content and the student's competency as certified by the award -- whether an individual course, a series of courses, or program completion.

The program specifications and expected outcomes must give consideration to the resources available for instruction over the time that a student plans to pursue his/her goal, and to the admissions standards to insure that the instructional program can facilitate the student's achievement of the stated competencies.

EVALUATION OF INCOMING STUDENTS

One of our most pressing problems in higher education is that students enter colleges with serious academic skill deficiencies. These deficiencies force institutions to provide remediation programs. A November 1983 conference called by the Conference Board of the Mathematical Sciences identified contributing factors in the current problem of math deficiencies that necessitate remediation.

Illustrative factors listed were:

1. The common practice during the past decade of "social promotion" of students in elementary and secondary schools.
2. Open admissions policies in public higher education.
3. The increased mathematical sophistication of work in many disciplines and professional training programs, leading to a rapid escalation of mathematics course requirements in high school.
4. Lack of societal support for mathematics education.
5. Lack of interest, motivation, and commitment on the part of students and faculty. (p. 16)

Developmental studies and remediation courses have as many working definitions as there are institutions and instructors in those

institutions. For example, demonstrating the wide divergence of the definition of remedial mathematics is one offered in 1965 by Dr. Bruce E. Meserve, who was then serving as president of the National Council of Teachers of Mathematics, to a conference sponsored by the College Section of the American Textbook Publishers Institute held in cooperation with the American Association of Junior Colleges. He defined "remedial mathematics" as any course "which precedes calculus. College algebra, trigonometry and analytical geometry are some examples." A review of the course listings of the nation's two- and four-year institutions would most likely reveal that a great majority of mathematics course offerings, using Dr. Meserve's definition, are at the "remedial level".

A recent Washington Post article quoted University of Texas professor John E. Rouche, author of a report on remedial programs scheduled for release in the fall, 1984, as stating that "the colleges are caught between a rock and a hard place". . . . and "they're stuck with students who want a college experience but lack the skills to handle it. On the other hand, their (the colleges') income depends upon enrollment so they've been forced to compromise." In the same article, Professor David Reisman of Harvard stated that "obviously, there have to be some standards to have achievement."

Universal access to college seems fair; but it has been destructive in that the level of achievement has slowly declined to meet the abilities of the learners. With 42 percent of national math enrollments in two-year colleges falling in the remedial category, it is apparent that existing standards or those that are established must drive the development of any testing programs which may be used for screening. Only by using testing programs that are in agreement with the expectations of constituency groups will the results be satisfactory to the community as a whole and only then will the specification of remediation be effective and acceptable. Rouche's national survey indicates that only a third of the students pass remedial courses the first time that they take them and the eventual pass rate is uncertain.

Those in postsecondary occupational education would do well to endorse several of The Conference Board of the Mathematical Sciences' recommendations relating to remediation. Those recommendations include:

1. Identification of exemplary and cost-effective programs for remedial education.
2. Development of appropriate text and non-text materials for remedial courses.
3. Improvement of diagnostic testing techniques that will better identify student difficulties and lead to more specific, and perhaps, less costly remedial efforts. (p.17)

Basic to the reduction and/or elimination of the remediation problem is the necessary progressive development of competency based materials for mathematics in grades K-12 to guarantee ability plateaus commensurate with the achieved grade level of the student. Evaluating students entering postsecondary institutions will then become more program

specific, assessing the mathematical base needed for success in their occupational field rather than testing to determine if entering students are at the threshhold of functional mathematics.

The successful testing program must incorporate the thinking of the general and technical education faculties and employer representatives. In particular, the involvement of the occupational education faculty and the employer advisory groups will remove the threat commonly voiced: "The academic (mathematics) faculty keep our students from getting into the institution by setting high standards and, then, once in, prevent them from completing because of the unrealistic expectations and the irrelevance of the content to our program."

In effect, sense can be made of the situation only through cooperative endeavors.

Ownership makes the difference.

SPECIFICATION OF REMEDIATION

The equation, (HS + RE) + PS = AAS/DIPLOMA/CERTIFICATE, perhaps, quantifies conceptually the situation in which we find ourselves. The equation symbols are: HS = high school mathematics; RE = remediation; PS = postsecondary mathematics. Mathematics instructors will agree most likely that each of the elements of the equation must either be known or have a finite value to result in a solution. However, because the equation does not represent quantifiable definitions, it is subject to the frailities of human nature. (HS + RE) + PS = AAS/DIPLOMA/CERTIFICATE is very appropriate to our application except when the expectation of RE exceeds the resources or the specification of RE is less than appropriate for the problem. However, the long range goal should be to reduce the equation to HS + PS = AAS/DIPLOMA/CERTIFICATE.

Society's expectation of high school graduates is that they will be prepared for either the world of work or for higher education. Curriculum developers in two-year institutions design programs based upon their knowledge of the skills high school graduates are certified to have and upon the assumption that students will bring twelfth grade competencies to the institution. The remediation effort being expended nationally by higher education is evidence that our expectations and assumptions are faulty. Therefore, to produce a graduate who meets the expectations of the institution and the program major, remedial education has been introduced to "guarantee" that our graduate will achieve the stated standards.

To meet this "guarantee", the burden of bringing the student "up to speed" is usually shifted from the occupational education department to the mathematics department and, often, from the mathematics department, to the remediation or developmental studies department. Here, too, there is a need for partnership. The remediation program too frequently resembles high school mathematics programs. Most frequently, little or no relationship exists between the college occupational or mathematics

faculties and the remediation department. These departments too often abrogate their responsibilities and await the results of the remediation only to find out too late that the diagnostic and prescriptive procedures were faulty and, as a result, the deficiencies still exist to a degree great enough to inhibit the student's full development -- and graduation. Without partnership and the active involvement of the prime investors -- occupational, mathematics, and remedial faculties -- the remediation will fall short and any deficiency will be the fault of the other party.

Ownership is the difference.

MAINTENANCE OF STANDARDS

The academic integrity of any institution is vested in the several constituent divisions -- administration as it relates to leadership, admissions as it relates to selectivity, instruction as it relates to learning, student welfare as it relates to counseling. All over the country in graduation exercises academic officers state to their presidents and to the audiences: "The faculty have reviewed each student's achievements and certify that these students have met all of their academic obligations and program requirements for the awards they are about to receive." This certification symbolizes the "academic integrity" of the institutions that is vested individually and collectively in the faculty and all other college divisions.

Graduation exercises highlight an important conflict that often exists between general education faculty and their standards, and the occupational faculty and their standards. The success or failure of graduates to demonstrate competencies gained from general education courses is most often not measured by competency on the job. The measures of quality all too often are the statistics of grade distribution. If too low a distribution is observed, the tendency is to be concerned with the admissions process. This initiates a feedback process which often results in the review of admissions standards and, may yield higher standards for admission or prerequisites for entrance into the regular general education courses.

The reaction of the occupational faculty when general education standards are set arbitrarily is to review the areas of course weakness -- often taken as those courses which "weed out" occupational students and prevent them from gaining an employable skill -- and recommend the elimination of certain courses from the curriculum on the basis of irrelevance. Or, more often than not, the occupational faculty insist that the general education courses are "just taking too much of the credit load for our students and the mathematics and physical science, etc., can be incorporated into the major courses without loss of content."

And, then, another integration occurs which places a general education course within the occupational department to "guarantee" quality control and graduation.

None of the problems that I have sketched in this brief presentation are insurmountable. All of them are significant, however, and they must be addressed if our colleges are to maintain their integrity, if they are to continue to graduate students who have competencies valued by employers, and if the colleges are going to continue to help skill-deficient students to develop to a level adequate to successfully complete technician level study programs. These problems cannot be addressed only by administrative fiat, although administrative mechanisms should be applied when necessary. The central players in this effort, however, are the faculties of the general education and occupational departments along with employer representatives. Their relationship must be a partnership, with each contributing equally to the work and with each sharing the accolades of success -- and the blame for whatever failures occur.

The concept and characteristics of ownership must be developed and accepted by general education departments/faculty so that a failure of a student or graduate is as impressed upon the general education faculty as it is upon the vocational/technical faculty. Only then will the establishment of standards, evaluation of incoming students, specification of remediation and the maintenance of standards serve the institution and students in a responsible fashion. Each partner must feel "ownership" in the program with a vested interest in the graduate.

Ownership makes the difference.

Ownership is the difference.

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